Two new magnetic cubic compounds: Pr$_3$Pt$_{23}$Si$_{11}$ and Nd$_3$Pt$_{23}$Si$_{11}$

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TWO NEW MAGNETIC CUBIC COMPOUNDS:
Pr$_3$Pt$_{23}$Si$_{11}$ AND Nd$_3$Pt$_{23}$Si$_{11}$

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The ternary system R-Pt-Si (R = rare earth element) has triggered a lot of interest, due to peculiar physical behaviors of some compounds: unconventional superconductivity, heavy-fermion properties, coexistence of superconductivity and magnetic ordering...

Recently, we synthesized for the first time two new compounds of the R$_3$Pt$_{23}$Si$_{11}$ series with Pr and Nd. They both crystallize in the same Fm-3m cubic space group as Ce$_3$Pt$_{23}$Si$_{11}$ [1-3]. The lattice parameter value is $a_{\text{Pr}} = 16.8634(3)$ Å and $a_{\text{Nd}} = 16.8493(4)$ Å for Pr$_3$Pt$_{23}$Si$_{11}$ and Nd$_3$Pt$_{23}$Si$_{11}$ respectively. Compared to those of the La and Ce compounds, these values are consistent with the lanthanide contraction.

From magnetic and heat capacity measurements, it is found that Nd$_3$Pt$_{23}$Si$_{11}$ presents a ferromagnetic order at 1.56 K, while Pr$_3$Pt$_{23}$Si$_{11}$ remains paramagnetic down to lowest reachable temperature. At higher temperatures, from 50K to 300K, the inverse of the magnetic susceptibility follows a Curie-Weiss law in both compounds. The effective moments, deduced from the experimental slope, are $3.55\mu_B$/Pr and $3.46\mu_B$/Nd respectively, in agreement with the theoretical values expected for trivalent ions (see figure 1). The deviations from the Curie-Weiss law below 50 K are ascribed to crystal electric field effects.

![Figure 1: Thermal variation of the inverse of the susceptibility for Pr$_3$Pt$_{23}$Si$_{11}$ and Nd$_3$Pt$_{23}$Si$_{11}$ (Pr curve has been offset by 20 T/$\mu_B$). Lines correspond to the Curie-Weiss law taking into account the theoretical values of the Curie contants of Pr$^{3+}$ and Nd$^{3+}$ ions.](image)

References